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IS 14548 (1998): Aircraft - Standby magnetic compass [TED 14: Aircraft and Space Vehicles]

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Indian Standard

AIRCRAFT — STANDBY MAGNETIC COMPASS — SPECIFICATION

ICS 40.090

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

March 1998

Price Group 5

Aircraft Electrical Equipments Sectional Committee, TED 15

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards after the draft finalized by the Aircraft Electrical Equipments Sectional Committee had been approved by the Transport Engineering Division Council.

The standby compass intended for use with aircraft which are subject to civil or military airworthiness requirements in India, shall be subject to inspection.

In the preparation of this standard, assistance has been derived from the following:

MIL-C-5604B Compass; Magnetic, Pilot's Standby

BSG-118 Aircraft Magnetic Compass Direct Reading

The committee responsible for the preparation of this standard is given in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant placed retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

AIRCRAFT — STANDBY MAGNETIC COMPASS — SPECIFICATION

1 SCOPE

This standard covers the requirements, tests and test methods for standby magnetic compass for use in aircraft which provides constant indication of aircraft heading, usually mounted in the pilot's field of vision.

2 GENERAL REQUIREMENTS AND ILLUSTRATION

2.1 Qualification

The compass specified in this standard shall be a product, samples of which have been tested and passed type tests specified herein.

2.2 Standard Parts

Standard parts or aeronautical standard shall be used wherever they are suitable for the purpose and shall be identified on the drawing by their part numbers. In the event there is no suitable corresponding standard parts, commercial parts having suitable properties may be used and simultaneously action shall be taken for type approval of the same.

2.3 An exploded view of standby magnetic compass shall be as given in Fig. 1.

3 MATERIAL

Materials shall be as specified in this standard. Materials which are not specifically described shall be of the best quality, of the lightest practicable weight, and suitable for the purpose intended.

3.1 Metals

Metals shall be of the corrosion resistant type, or shall be suitably protected as specified to resist corrosion due to salt spray or atmospheric conditions that may be encountered in storage or during normal service life.

3.2 Dissimilar Metals

Unless suitably protected against electrolytic corrosion, dissimilar metals such as brass and copper shall not be used in intimate contact with each other.

3.3 Nonmagnetic Materials

Nonmagnetic materials shall be used for all parts of the compass except where magnetic materials are essential.

3.4 Fungus Proof Materials

Materials which are nutrients for fungi shall not be used where it is practicable to avoid them. Where used and not hermetically sealed they shall be treated with a fungicidal agent. However, if they will be used in a hermetically sealed enclosure, fungicidal treatment will not be necessary.

3.5 Corrosive Fumes

The materials as installed in the compass and under the service conditions specified herein shall not liberate deleterious fumes.

4 DESIGN AND CONSTRUCTION

The dimensions of the compass shall conform to the relevant drawings to be provided by purchaser. The design of the compass shall be reasonably simple to permit overhaul or repair with a minimum of special tools and fixtures. The compass shall be constructed to withstand the normal strains, vibrations and such other conditions as are incident to shipping, storage, installation and service.

4.1 Serviceability

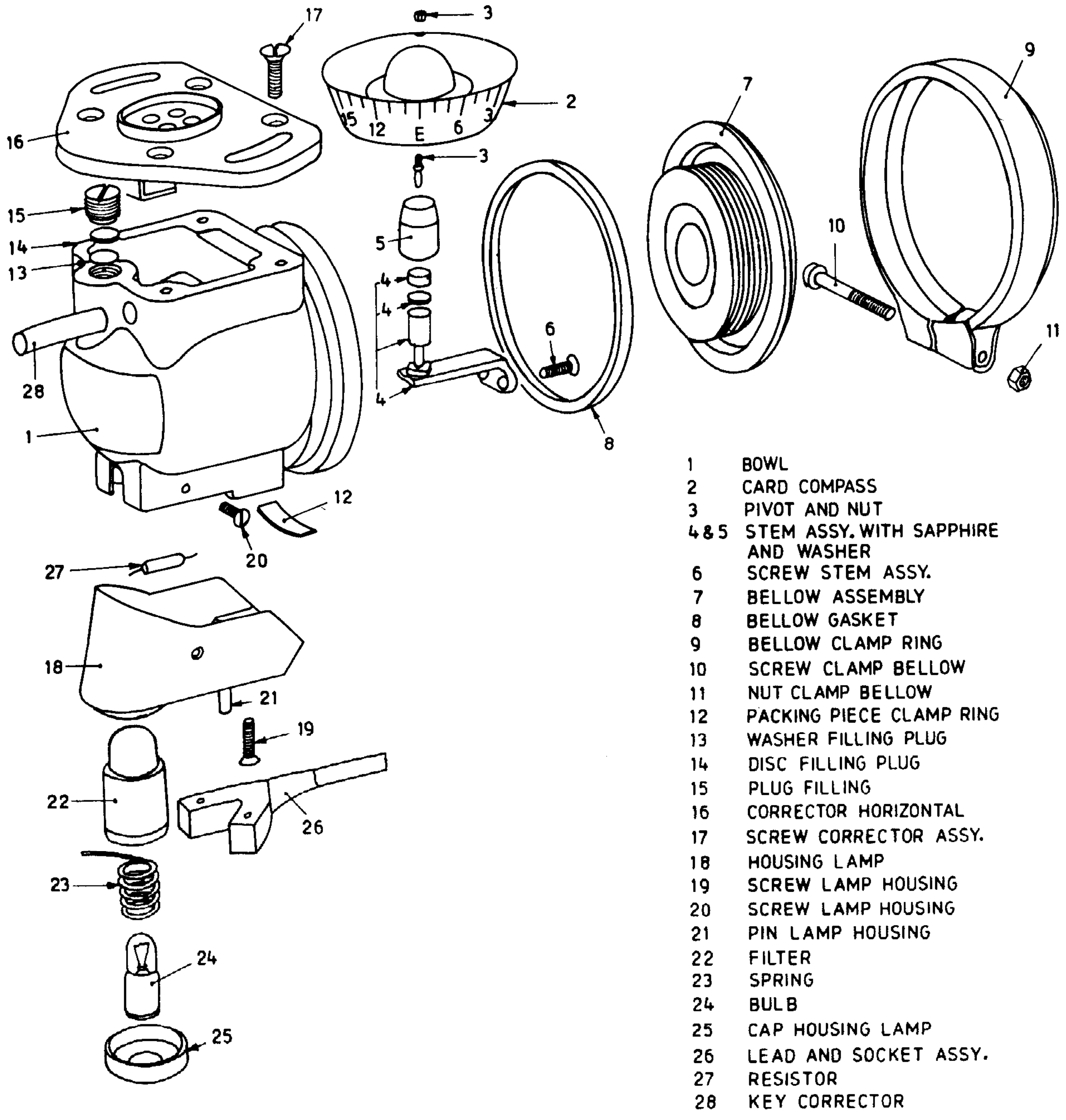
The design of the compass shall be such as to facilitate to the greatest possible extent disassembly, reassembly and service maintenance by those tools and items of maintenance equipment which are normally available as commercial standards.

4.2 Reliability

The compass shall be designed and constructed as specified in a manner that will ensure highest degree of operation reliability under all service conditions.

4.3 Compass Bowl

The compass bowl forms the main body of the compass. The bowl shall be transparent, easily machinable, free from colouration, scratches and internal strain. It shall be dimensionally stable even in the extreme temperature ranges of −40°C to +85°C. It shall be inert to the compass fluid used for filling the compass. It shall be provided with means



1	BOWL
2	CARD COMPASS
3	PIVOT AND NUT
4 & 5	STEM ASSY. WITH SAPPHIRE AND WASHER
6	SCREW STEM ASSY.
7	BELLOW ASSEMBLY
8	BELLOW GASKET
9	BELLOW CLAMP RING
10	SCREW CLAMP BELLOW
11	NUT CLAMP BELLOW
12	PACKING PIECE CLAMP RING
13	WASHER FILLING PLUG
14	DISC FILLING PLUG
15	PLUG FILLING
16	CORRECTOR HORIZONTAL
17	SCREW CORRECTOR ASSY.
18	HOUSING LAMP
19	SCREW LAMP HOUSING
20	SCREW LAMP HOUSING
21	PIN LAMP HOUSING
22	FILTER
23	SPRING
24	BULB
25	CAP HOUSING LAMP
26	LEAD AND SOCKET ASSY.
27	RESISTOR
28	KEY CORRECTOR

FIG. 1 EXPLODED VIEW OF STANDBY MAGNETIC COMPASS

of preventing leakage of the fluid or formation of bubbles over a range of temperature from −40°C to +85°C. The bowl shall be painted on the outside surface except for a clear portion at the front through which the compass card is viewed. The lubber line shall be suitably filled in white and will be protected by the application of suitable varnish.

4.3.1 *Mounting Flange*

The mounting flange shall form an integral part of the compass.

4.3.2 *Expansion Unit*

The bowl shall incorporate a suitable expansion unit to permit the liquid to contract or expand as a result of temperature and altitute changes.

4.3.3 *Filler Cap*

The bowl shall incorporate a suitable filler cap so placed that the compass may be easily filled with the liquid.

4.3.4 *Gaskets*

Gasket shall be made of material suitable for holding the damping liquid within the bowl. Sealing agents shall be of such nature that they will not contaminate the liquid.

4.3.5 *Jewel*

The cup jewel shall be made of sapphire, free from surface flaws.

4.4 Magnets

The compensating and card magnets shall be made of suitable magnetic material and suitably heat-treated, magnetized to saturation and aged to insure optimum performance.

4.5 Card Assembly

The card assembly shall be as light in weight as practicable and sufficiently rigid to withstand service usage.

4.5.1 *Card*

The card shall be constructed of aluminium, aluminium alloy or other nonmagnetic material and shall be graduated at 10° intervals on the outside face. In addition, marking at intervals of 45° shall be marked in red. It shall also be marked with letters 'N S E W' at appropriate intervals.

4.5.2 *Card Pivot*

The card pivot shall be constructed of high grade steel or other suitable alloy properly hardened and polished on its working surface.

4.6 Compensating System

The compensating system shall consist of manually adjustable magnetic systems for removing the compass deviation 'C' corrector on N-S (North-South) and B corrector on E-W (East-West) headings. Both systems shall be provided with a zero index mark to show, when the system is in operation, where it exerts zero effect on the indication. The design of the systems shall be such that the zero index mark will read zero only when the system is in its zero effect position. The compensating system shall be attached to the underside of the compass mounting plate.

4.6.1 *Adjustment of Compensator*

Adjustment shall be accomplished from the front of the compass. Each system shall be provided with a screw type adjustment suitable for operation with a screw driver. The compensator gearing shall be such that the change in compensation for equal angular displacements of the adjusting screws shall be the same for both N-S and E-W systems. It shall be possible to turn either adjustment continuously in one direction without meeting a stop, the compensation resulting from this treatment passing through complete cycles repeatedly. The compensator systems shall have sufficient friction in their operation to prevent changes in adjustment caused by vibration encountered in service. With compass heading north, a slight turn of the N-S compensator screw, off the zero position shall change the reading of the compass card. With the compass heading east, a slight turn of the E-W compensator screw off the zero position shall change the reading of the compass card.

4.7 Lighting System

The compass shall be provided with an integral system designed to receive a 28 d.c. volt power supply in the electrical connector socket and an integral dimmer may also be provided. The lighting system shall be so designed that there will be no difference in the operation of the instrument with or without the lamp in 'ON' position.

4.7.1 *Lamp Housing*

Lamp housing shall be made of bakelite and shall be screwed by means of four suitable screws, on the underside of the compass bowl. It shall carry a suitable lamp inside and a pair of two pins outside. A coloured filter glass shall be provided to cover the lamp. The colour of filter glass may be red/green/clear depending upon users requirement.

4.7.2 *Lamp*

The lamps shall be made of non-magnetic materials. The lamp shall be replaceable in flight without the use of tools.

4.7.3 *Lead and Socket Assembly*

The lead assembly shall carry a rubber moulded socket at one end to engage the pair of pins on the lamp house. The other end of the leads shall be connected to the brilliance control rheostat.

4.8 Compass Liquid

The compass liquid of visocity 3.0 ± 10 percent centistokes shall be clear and free from bubbles and shall contain no materials likely to cause dislocation of the bowl or compass system. The silicon fluid shall not become milky at – 40°C. Where a bubble trap is provided, bubbles shall not be formed in such a way as to interfere with the performance of the compass. The compass liquid shall be de-aerated during the filling process, and the compass shall be capable of being used at pressures ranging from sea level to declared altitude without derangement or formation of bubbles in the liquid.

5 INTERCHANGEABILITY

All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance.

6 SCREW THREADS

Screw threads shall be 1.5 mm or larger in diameter.

7 WEIGHT

The weight of the compass shall not exceed 0.11 kg.

8 FINISH

Protective coatings and finishes which will crack, chip, or scale due to normal service life or during extremes of atmospheric conditions shall not be used.

8.1 Aluminum Alloy Parts

Where practicable, aluminium alloy parts shall be covered with an anodic film.

8.2 Exposed Metallic Parts

Exposed metallic parts shall be coated with durable black baked enamel or other durable black finish. All external surfaces which are visible to the pilot when the compass is mounted shall have a durable black finish with minimum gloss.

8.3 Brass and Bronze Parts

All brass, bronze, or copper-bearing alloys, except bearing surfaces coming in contact with the compass liquid, shall be cadmium plated or chromium plated or zinc plated or tin plated and finished in a durable black.

9 FILLING

The compass shall be thoroughly cleaned at the proper stage of assembly and shall be completely filled with compass liquid at a temperature of approximately 25°C.

10 SAMPLING

The manufacturer shall submit three samples for testing. Performance tests listed in **11** and vibration test, acceleration test, leak test and water proofness test shall be carried out on all the three samples. One sample out of the above three to be subjected to high temperature, high altitude, low temperature, humidity and fungus growth tests. The second sample shall be subjected to tropical exposure test and the third sample shall be subjected to salt sea atmosphere and sand and dust tests.

11 PERFORMANCE

11.1 The compass card shall be checked for its smooth and adequate movement. It shall not touch the walls of the compass bowl when moving freely both in horizontal plane and in a plane inclined at 18° to the horizontal.

11.2 Directional Error

The directional error of the compass on any heading shall not exceed ± 2°.

11.3 Balance

The compass shall be held in its normal operating position. The deviation of the plane of the card from the horizontal, as determined by any suitable method, shall not exceed 1°.

11.4 Time of Swing

The card shall be magnetically deflected 90° from the meridian and held there for an interval of 30 s in order to allow the compass liquid to settle. The time measured shall be between 1 to 2 s for the system when released to return to 5°, that is, through an angle of 85°. (This condition applies to latitude 12 degrees 57 minutes where the earth's horizontal field strength is 0.037 6 oersted.)

11.5 Frictional Error

The compass card shall be deflected 10° and then released first on one side of the meridian and then on the other. The angular distance between the two settling positions will be termed the frictional error and this error shall not exceed 1.5°. (This condition applies to latitude 12 degrees 57 minutes, where the value of the earth's horizontal magnetic field strength is 0.376 oersted). During this test the compass shall be kept free from vibration.

11.6 Angle of Heel or Tilt

When the compass is tilted from the horizontal, through an angle of 18°, the magnet system shall remain free to rotate on its pivot. The compass shall not swing more than 1° at tilt or heel from its normal operating position.

11.7 Lubber Line

The compass shall be held in its normal operating position. The deviation of the lubber's line from the vertical, as determined by any suitable method, shall not exceed one degree. The compass need not be subjected to the specified magnetic field for this test.

11.8 Magnetic Moment

The magnetic moment for the card shall be 42.5 ± 3.5 C.G.S. units.

11.9 Horizontal (B and C) Correctors

With both the correctors set to neutral position the compass shall be placed with the lubber line at N, rotation of the (C) operating head shall cause extreme deflection on either side of N which shall not be less than 12°. The difference between the two deflections shall not exceed 4°.

With the lubber line at E, rotation of the 'B' operating head shall cause extreme deflection on either side of 'E' which shall not be less than 12°. The difference between the two deflections shall not exceed 4°. (This condition applies to altitute 12 degrees 57 minutes where the value of the earth's magnetic field strength is 0.376 oersted.)

11.10 Damping

The card shall be magnetically deflected 30° from the meridian, held at this position long enough for the liquid to settle, then released and the overswing past the meridian position noted. The test shall be repeated with deflection of 30° in the opposite direction. The average of two observations shall not exceed 15°.

11.11 Swirl Error Test

The compass shall be mounted in its normal horizontal position with magnet system lying in the meridian. After allowing the magnet system to settle, the compass shall be rotated at a uniform rate through 360° in 30 s. The maximum deflection of the magnet system from its original position immediately following the 360° rotation shall not exceed 2°.

11.12 Illumination

With the rated voltage applied to the connector, the card markings and lubber's line shall be uniformly illuminated without glare. With voltage decreasing, the uniformity of illumination shall not appreciably vary. The compass shall be observed under conditions of both twilight and complete darkness.

11.13 Insulation

With the lamp removed, the electrical circuit shall be subjected to a potential of 250 volts d.c. and the insulation resistance measured. It shall not be less than 20 megaohms.

12 ENVIRONMENTAL TESTS

12.1 The compass shall satisfy the performance requirements specified in **11** under any of the following environmental conditions or natural combination of the conditions. These may be defined as per aircraft on which the compass is supposed to be used/installed.

a) Vibration test;

b) Acceleration test;

c) Leakage test;

d) Combined temperature, pressure and humidity test;

e) Resistance to fungus growth test;

f) Tropical exposure test;

g) Salt corrosion test; and

h) Sand and dust test.

12.1.1 The method of test shall be as given in Annex A.

13 TESTS

13.1 Type Test

a) Visual examination and finish;

b) Dimensional checks;

c) Directional error test;

d) Balancing;

e) Frictional error;

f) Horizonal (B and C) corrector;

g) Tilt test;

h) Swirl error test;

j) Test for parallel error;

k) Electrical test;

m) Tapping test; and

n) Silicon fluid test.

13.1.1 The method of test shall be as given in Annex A.

13.2 Routine Tests

a) Visual examination and finish;

b) Directional error test;

c) Balancing;

d) Time or running;

e) Frictional error test;

f) Tilt test;

g) Swirl error test;

h) Magnetic movement test;

j) Electrical test; and

k) Dry heat and cold test.

13.2.1 The method of test shall be as given in Annex A.

14 MARKING

All markings shall be durable to withstand usage encountered in service. The colour of the markings shall be lustreless white and red or fluorescent luminescent material, as specified by the procuring service. The catalogue/part number, nomenclature, manufacturer's initial/trade-mark and the year of manufacture shall be marked at a suitable place on the instrument.

15 STORAGE

15.1 The compass shall be stored in the box in which it was received from the manufacturer.

15.2 The compass shall be kept away from strong magnets or electrical apparatus. It should be handled with care avoiding violent movement or bump.

ANNEX A

(*Clauses* 12.1.1, 13.1.1 *and* 13.2.1)

METHOD OF TEST

A-1 LIST OF EQUIPMENT

A-1.1 The equipment required for conducting various tests are given in the table below. Special features of use of these equipments are also shown against each item.

Sl No.	*Description*	*Special Features of Use*
a)	Divided test table non-magnetic	Rotatable table carrying a circular divided scale on which various mountings and brackets can be fixed
b)	Mounting bracket horizontal	For various test, friction error, headings errors, etc
c)	Mounting bracket for tilt test	For tilt test
d)	Standard magnetic needle with nonmagnetic suspension stirrup	For making magnetic meridian
e)	Deflector magnet	Used for deflecting compass card for test
f)	Corrector key	Corrector deflection
g)	Vacuum chamber or de-aeration unit	For leakage test

Sl No.	*Description*	*Special Features of Use*
h)	Vacuum pump	For leakage test
j)	Cold chamber with thermostat	For low temperature test with thermostat at – 40°C
k)	Stop watch	For checking time of swing
m)	Multimeter	Resistance check
n)	Insulation tester 250 V DC	Insulation test

A-2 The following tests should be carried out after overhaul. These tests are necessary to certify the serviceability of the compass:

a) Directional error test;
b) Frictional error test;
c) Time of swing test;
d) Tilt test;
e) Corrector range and zero test;
f) Leak test;
g) High temperature test;
h) Low temperature test;
j) Electrical test; and
k) Silicon fluid test.

All tests shall be carried out at temperature 20°C to 25°C.

A-3 PROCEDURE

A-3.1 Directional Error Test

a) Mount the compass on the divided test table on horizontal mounting.

b) Set all correctors exactly to the neutral position.

NOTE — A misalignment of 0.254 mm that is, the width of an index line will produce a deviation error in the compass of 2½ degree.

c) Rotate the table clockwise in 90 degree steps, note the card errors at N, E, S and W headings.

i) The algebraic sum of the errors N+S and E+W respectively shall not exceed 5 degrees.

ii) The algebraic difference of the errors N–S and E–W respectively shall not exceed 5 degrees.

NOTE — These readings are taken at a location when the earth's magnetic field is not distorted due to ferro magnetic materials or current carrying conductors in the vicinity.

A-3.2 Frictional Error

a) Mount the compass horizontally on the table.

b) Deflect the compass through 10 degrees with a deflector magnet, and maintain in this deflected position for 10 s.

c) Release the card and note the settling position.

d) Repeat the operation in the opposite direction.

e) The difference in the settling position of 3 and 4 is the friction error. This error shall not be more than 1.25 degree.

A-3.3 Time of Running Test

a) Mount the compass horizontally on the table.

b) Using a deflector magnet deflect the compass card through 90 degrees and maintain in this deflected position for atleast 10 s.

c) Release the card.

d) Observe that the card returns through 85 degree and note the time.

e) This reading shall be between 1.3 to 2.1 s at 0.36 H and between 2.0 to 3.0 s at 0.18 H.

NOTE — The time of swing is influenced by the place of the experiment.

A-3.4 Tilt Test

a) Mount the compass on the tilt stand which is mounted on the divided test table.

b) Tilt the table by 18 degrees from the horizontal and clamp in this position.

c) Rotate the table through 360 degrees.

d) The compass card shall not stick anywhere during this rotation and remains free.

e) Tilt the table by 18 degrees on other side of the horizontal and clamp in this position.

f) Rotate the table through 360 degrees.

g) The compass card shall not stick anywhere during this rotation and remains free.

A-3.5 Corrector Range and Zero Test

a) Mount the compass on the divided test table on horizontal mountings.

b) Ensure that all correctors are exactly at neutral.

c) Rotate the table and align the lubber line with 'N' on the card.

d) Rotate the 'C' corrector through 90 degrees both sides and observe that the card is deflected not less than 12 degrees to each side of the lubber line. The difference between the readings of the two maximum deflection does not exceed 4 degrees.

e) Rotate the table and align the lubber line with 'E' on the card.

f) Rotate 'B' corrector through 90 degrees both sides and observe that the card is deflected not less than 12 degrees to each side of the lubber line. The difference between the readings of the maximum deflection does not exceed 4 degrees.

A-3.6 High Temperature Test

a) Place the compass in the electric oven.

b) Maintain the temperature to +70°C for 4 h.

c) Check at the end of 4 hours at +70°C that no leak shall occur from the compass.

d) Slowly allow temperature to come back to room temperature.

e) Check compass for any crack or deterioration.

A-3.7 Low Temperature Test

a) Place the compass in cold chamber.

b) Reduce the temperature to –40°C and maintain it for 4 h.

c) Check at the end of 4 h at –40°C that no bubble shall form.

d) Slowly allow temperature to come back to room temperature.

e) Check compass for any crack or deterioration.

A-3.8 Leakage Test

a) Place the compass in vacuum chamber.

b) Reduce the pressure to maintain a vacuum of 100 mm Hg absolute for 20 min and observe that no bubbles form in the liquid and no sign of leakage.

A-3.9 Electrical Test

a) Remove the lamp from the housing.

b) Measure the insulation resistance between the two connecting pins.

c) When measured with a 250 V 'Megger' the reading obtained shall not less than 20 megaohm.

d) Fit the lamp.

e) Connect the electrical supply of 28V d.c. to the pins.

f) Observe that the card is illuminated satisfactorily.

A-3.10 Silicon Fluid Test

a) Examine the compass liquid for freedom from bubbles, sediments cloudiness and discolouration.

b) Examine the compass for sign of leakage.

c) Using the de-aeration unit maintain a vacuum of 4 IN Hg absolute for 20 min and observe that no bubbles form in the liquid.

d) Check the compass liquid after low temperature test for not becoming turbid. It shall not freeze. If the liquid becomes turbid, it indicates moisture finding its way in the liquid and such a liquid shall be discarded.

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Aircraft Electrical Equipment Sectional Committee, TED 15

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Shri A. R. Gulati, Director (Transport Engg)	Director General, BIS (*Ex-officio Member*)

Member Secretary

Shri M. L. Chopra
Director (Transport Engg), BIS

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards : Monthly Additions'.

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